



AGRICULTURE AND FOOD AUTHORITY

HORTICULTURAL CROPS DIRECTORATE

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CABBAGE (*Brassica oleracea* var. *capitata*) GROWERS MANUAL

PREFACE

Kenya has been endowed with an enabling environment for production of horticultural crops that attracts high demand both in the domestic and international markets. Production is mainly by smallholder farmers, many of whom require skills and knowledge on good agricultural practices (GAP) to produce and handle the fresh produce. According to the Economic Survey 2022 published by the Kenya National Bureau of Statistics (KNBS), horticulture is among the leading sub sectors in agriculture. Therefore, enhancing the capacity of these producers could be of immense beneficial to the Kenyan economy.

Agriculture and Food Authority – Horticulture Crops Directorate (HCD) is a government agency mandated to Regulate, Promote and Develop the horticulture industry in Kenya. In carrying out its mandate, the Directorate through the Technical and Advisory Services department (TAS) has developed this grower’s manual for its stakeholders. The manual has been designed with a simple language and where necessary photos have been used to highlights all processes from plough to plate. HCD envisages that by using this grower’s manual, its stakeholders especially the smallholder farmers, extension staff and trainers would upgrade their knowledge and skills to enable them increase production of the crops thereby improving on food security, household health, as well as create employment and generate income.

The content has largely been developed from the TAS field staff experiences in the 26 stations spread across the country (*Collins & Dinah – Nairobi [NHC], Antonina – Nakuru, Miriam - Nandi, Grace – Homabay, Barnabas- Eldoret & Iten, Carol - Bungoma, Peter- Busia, Charles -Kisumu, Irene - Narok, Lal – Kisii, Victor – Mombasa, Crispin – Kibwezi, Esther Ngutho–Kitui, Esther Kabatha – Nyandarua, Susan – Taveta, Syphrosa – Machakos, Catherine – Yatta, James – Kitale, Julius – Kajiado, Amedeo & Brenda – Meru, Mary – Kericho, David & Delphina – Mwea, Fridah – Nyeri, Emma – Sagana, Sarah – Limuru*), some content were reviewed from literature and images used properly acknowledged. Technical editing and reviewing of the manuals were done by Mary Chacha, Syphrosa Wanyama, Barnabas Kiptum, Antonina Lutta, Carol Soita, Amedeo Muriungi, Peter Mwanja, Victor Omari, Emma Ndirangu, Esther Kabatha, David Makori, Dinah Karimi, Collins Otieno, Dr Jacqueline Oseko the acting Deputy Director, Technical and Advisory Services department and Director Benjamin Tito all of Horticulture Crops Directorate.

CABBAGE (*Brassica oleracea* var. *capitata*) GROWERS MANUAL

Common name: Kabeji (Swahili)



Introduction

Cabbage is a vegetable of importance for cooking and for salads and also as a plant matter in animal feeds. Cabbage is a source of vitamins and minerals. The major cabbage varieties in Kenya are Pruktor F1, Queen F1, Riana F1, Serena F1, Gloria F1, Blue dynasty F1, Baraka F1 and Kiboko F1 among others.

In Kenya, the leading cabbage producing counties are: Nyandarua, Narok, Nakuru, Meru Nyeri, Kiambu, Kisii, Bomet, Elgeyo marakwet, Murang'a and Tran Nzoia.

Ecological requirements

1. Temperature range –seed germination 25 °C to 30°C, while for growth and head formation is 15 °C to 20°C.
2. Rainfall - Optimal rainfall of 500mm.
3. Soils - Well drained sandy or silty loam soils. High organic matter content and optimum pH 6.0 – 6.5.
4. Altitude - 700 – 2,200m above sea level.

Good Agricultural Practices (GAP)

Horticulture industry in Kenya is guided by a code of practice (KS1758-2016 part II) which is a standard for vegetable, fruits, herbs and spices for both local and export market. The standard aims at ensuring food safety, environmental sustainability and social accountability by following good agricultural practices from production, processing, transportation and marketing of fresh produce. It is essential to maintain accurate records for all operations for ease of traceability.

Propagation materials

Certified cabbage seeds are acquired from registered seed companies or stockists, then the farmer raises seedlings or seedlings can be acquired from registered commercial nurseries.

Soil testing

Soil testing is recommended before planting to guide on fertilizer and manure application.

Land preparation and planting

Cabbage is a shallow rooted plant; therefore, deep tillage is not required, however, the soil needs to be worked well, with no clods or rocks. Crop rotation out of a cruciferous crop is needed to avoid persistent disease problems. Therefore, consideration of history of previous crop is required.

Recommended spacing is 60 cm between rows and 45 – 60 cm between plants depending on the variety. Plant population: 11,000 – 18,800 plants/acre.

At planting, apply 2 – 3 handfuls of manure per planting hole (8 tons/acre) and (10 g) of DAP per planting hole (80 kg/acre).

Irrigation

To maintain growth, cabbage requires a consistent supply of moisture throughout growth period. Regular watering ensures uniform head formation, prevent head splitting and increases the size of the head.

Fertilizer application

Top dress crop two weeks after transplanting with 1 teaspoonful of CAN per plant. Apply a second topdressing at same rate when leaves begin to fold. Excess nitrogen (N) may cause loose head formation and internal decay.

Potassium (K) deficiency can result in marginal necrosis and lower head quality, but its excess can cause the heads to open (**NB: Fertilizer application rates is guided by soil and leaf analysis**).

Weeding and mulching

Keep fields free of weeds to reduce competition for nutrients, light and space. Also to reduce pests and disease infestation. Cabbages are shallow rooted thus minimum tillage is desired.

Mulching of the soil with material such as crop residues, compost or plastic sheeting to reduce water loss, splashing and break some pest life cycles.


Pest management





Integrated Crops Management (ICM) is the best option for food safety. These methods include scouting of pest, field hygiene, proper spacing; physical methods like use of traps, pheromone, biological methods and others that will only give an option of using pesticide as a last option.

ICM strategies in cabbage control of pests

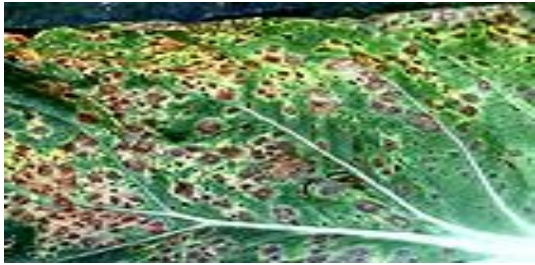

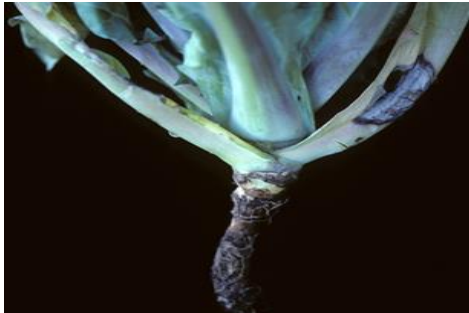

1. **Use of pest resistant varieties:** This ensures your crop has natural resistance to pests and diseases, minimizing the need for expensive chemical control.
2. **Weeding:** weeds act as host plants for diseases and pest.
3. **Crop rotation:** Do not plant cabbages more than once every 3 – 4 years in the same field. This will minimize the risk of fungal and bacterial diseases.
4. **Soil solarization:** This involves preparing land to a fine tilth so as to expose soil to the sun for one month during the hot season. This helps to control soil borne pathogens, soil insects, weeds and root-knot nematodes.
5. **Companion crops:** Planting corn and squash as a trap crop around the borders of your cabbage crop to keep aphids away, reducing the incidence of turnip mosaic virus.
6. **Traps:** Placing yellow and blue sticky traps and pheromone traps around your cabbage crop will help control whitefly, leaf miners and caterpillars.
7. **Field hygiene:** Removing and destroying all crop residues immediately after harvest: All crop residues should be removed and destroyed by burning or burying in deep pits. This helps prevent last season's pests including caterpillars, aphids and beetles re-infesting your new crop and also control fungal and bacterial diseases.

Major cabbage pests





| Pests | Symptoms | Control |
|---|--|---|
| <p>1. Diamond Back Moth (DBM) – <i>Plutella xylostella</i></p>  | <p>Windowing – irregular holes on the leaves</p> | <p>Cultural control Use of <i>Bacillus thuringiensis</i> (Bt), Intercropping with repellants (e.g. Tomato) or trap crops (e.g. Indian Mustard) reduces DBM destruction.</p> <p>Chemical control Thiamethoxam, Flubendiamide, Chlorantraniliprole, Deltamethrin.</p> |

| | | |
|--|---|---|
| <p>Source: SHEPPLUS 2016</p> | | |
| <p>2. Cabbage Sawfly – <i>Athalia spp</i></p>  <p>Photo: © A. M. Valera, icipe</p> | <p>The grayish green larvae feed on the blade of the leaves often leaving only the main veins and midrib.</p> | <p>Cultural control Destruction of wild plants in the Cruciferae family; Ploughing in of volunteer plants at the end of the season helps reduce sawfly populations; Manual collection and destruction of larvae is feasible when there are few sawflies on the crop.</p> <p>Chemical control Methomyl 25%, Imidacloprid</p> |
| <p>3. Cabbage Aphids – <i>Brevicoryne brassicae</i></p>  <p>Source: SHEPPLUS 2016</p> | <p>Leaves are curled, distorted, wrinkled, or cup-shaped.</p> | <p>Cultural control Field hygiene through removal and destruction of crop residue; Planting corn and squash as a trap crop around the borders of your cabbage crop keeps aphids away.</p> <p>Chemical control Sulfoxaflor, Imidacloprid, Azadirachtin</p> |
| <p>4. Slugs</p>  <p>Information Source: http://cvp.ece.cornell.edu, http://stephigardens.com</p> | <p>Found under the leaves. Reduced quality and marketability</p> | <p>Cultural control Use slug pellets; drowning the slugs in water (bury tins at ground level and fill with water) and add yeast to attract the slugs.</p> |
| <p>5. Cutworm – <i>Agrotis spp</i></p>  <p>Source: SHEPPLUS 2016</p> | <p>Plant stem is clipped very near or just below the soil surface</p> | <p>Cultural control Hand removal since the pest is easily found near the damaged plant, especially at the beginning of infestation; Early weeding destroys sites for egg laying; Flooding of the field for a few days before sowing or transplanting can help kill cutworm caterpillars in the soil.</p> <p>Chemical control Thiamethoxam</p> |

Diseases, symptoms and control

| Disease | Symptoms | Control |
|---|--|--|
| <p>1. Alternaria / Dark Leaf Spot</p>  <p>Source: SHEPPLUS 2016</p> | <p>First appears as small dark brown or black spots on the leaves.</p> | <p>Cultural control Destroy old plant beds and harvested fields; crop rotation; planting clean seeds or seedlings.</p> <p>Chemical control Mancozeb 64%</p> |
| <p>2. Bacterial Soft Rot</p>  <p>Source: SHEPPLUS 2016</p> | <p>Plant tissues first develop a water-soaked lesion that enlarges rapidly in diameter and depth.</p> | <p>Cultural control Use certified planting material; Use of tolerant varieties; Field sanitation (hygiene); Two-year crop rotation.</p> <p>Chemical control Bronopol 27%w/w</p> |
| <p>3. Black Leg (Dry Rot Canker)</p>  <p>Photo: Umass Extension Vegetable Program</p> | <p>Light brown spots on leaves which later develop ash grey centers with many black spots</p> | <p>Cultural control Use of certified seed; Field sanitation (hygiene); 3 – 4-year crop rotation.</p> <p>Chemical control Mancozeb</p> |
| <p>4. Ring Spot</p>  <p>Information Source: http://masters.agron.iastate.edu</p> | <p>Circular brown grey spots on the leaves which are often bordered by a green margin and with black-specked concentric zones.</p> | <p>Cultural control Use of certified seeds; Crop rotation for at least 2 years.</p> <p>Chemical control Fosetyl-Aluminium.</p> |

Nutrients deficiency

| Element | Deficiency symptoms | Control |
|--|---|---|
| Potassium  Source: SHEPPLUS 2016 | Older Leaves show a light brown and withered necrotic border zone. With ongoing deficiency necrosis progresses from the edge to the middle. Leaf margins are cupped upwards. | Manage by applying fertilizers rich with potash |
| Magnesium  Source: SHEPPLUS 2016 | Starts on older leaves. Chlorosis between the veins progresses from the margin to the middle of the leaf. First the affected areas turn yellow-green, later color changes to orange or red. | A foliar application with a complete fertilizer can address magnesium deficiency. |
| Calcium  Source: SHEPPLUS 2016 | "Tip-burn", which means necrotic lesions on leaf tips and margins. The symptoms start on younger leaves. With ongoing Ca deficiency necrosis progresses from tips and margins inwards. | Liming or foliar application of a calcium rich fertilizer. |
| Boron  Source: SHEPPLUS 2016 | It starts on the younger leaves. They remain small, are curled down and become deformed. The leaves show chlorotic mottling on the edges and between the veins. Necrosis may appear on leaf margins and intercostal fields. | Foliar application of a boron rich fertilizer. |

Cabbage harvesting

Maturity Period of 2.5 – 4 months after transplanting depending on variety and location. Heads are cut when they are firm. The ideal is to have a high first cut percentage (80% +), this can be achieved through good management and choosing a cultivar that produces uniform heads. Cut heads at the base and leave the outer leaves to protect the head and keeping it fresh.

Maturity indices

Maturity indices are indication of readiness of cabbage for harvest. These includes:

1. When the head becomes firm and fully formed.
2. Maturity Period of 2.5 – 4 months after transplanting depending on variety and location.

Harvesting hygiene

Avoid bruising the head as it encourages rotting. Keep produce under shade. Harvesting environment, tools and field containers must be clean to avoid contamination. Personal hygiene for harvesters is important and facilities such as hand wash and clean accessible toilets should be available as a measure of ensuring food safety is maintained. Harvesters need to be trained on harvesting techniques. Minimum cabbage handling is advised to reduce bruising during harvesting.

Yields

15 – 68 tons per acre (depending on the variety and crop husbandry). Varieties with firm solid heads have good storability.

Post- harvest handling techniques

1. **Sorting:** Damaged and diseased heads are discarded
2. **Grading:** Cabbages are graded depending on the head size: small (1 – 2 kg), medium (3-4 kg) large over 5kg.
3. **Packaging:** Packaging of harvested cabbages should be done to maintain quality, preferably in clean well ventilated containers/crates and transported in closed trucks as per the Crops (Horticultural Crops) Regulations 2020.

Gross margin analysis for 1 acre (2023)

| Item | Unit | Quantity | Cost/unit | Total cost |
|--------------------------|-----------------|---------------|-----------|----------------|
| Gross Income (GI) | Per head | 18,000 | 20 | 360,000 |
| Variable Costs | | | | |
| Seeds(Gloria F1) | gms | 100 | 4000 | 4,000 |
| Land leasing | acre | 1 | 15,000 | 10,000 |
| Soil test | 1 | 1 | 2500 | 2,500 |
| Manure | Tons | 1 | 10000 | 10,000 |
| Fertilizers (NPK/DAP) | Kgs | 80 | 130 | 10,400 |
| Fertilizer(CAN) | Kgs | 50 | 120 | 6,000 |
| Foliar fertilizer | Lts | 3 | 800 | 2,400 |
| Fungicide | Kgs | 2 | 1000 | 2,000 |

| | | | | |
|---|------------------|---|------|---------------------------------|
| Insecticide | Lts | 3 | 800 | 2,400 |
| Nursery management | Mds | 3 | 500 | 1,500 |
| Ploughing | Tractor per acre | 1 | 4500 | 4,500 |
| Harrowing | Tractor per acre | 1 | 3500 | 3,500 |
| Furrowing | Tractor per acre | 1 | 3500 | 3,500 |
| Transplanting | Mds | 5 | 500 | 2,500 |
| 1 st Weeding and top dressing | Mds | 7 | 500 | 3,500 |
| 2 nd Weeding | Mds | 7 | 500 | 3,500 |
| Spraying | Mds | 3 | 500 | 1,500 |
| Harvesting, sorting and grading | Mds | 8 | 500 | 4,000 |
| Total Variable Costs | | | | 82,700 |
| Gross margin (gross income – total variable costs) | | | | 360,000-82,700 = 277,300 |

NOTE: As per this GM, a farmer should not sell one cabbage head for less than 5 shilling, as 5/= is the break-even price.

References

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